FAULT EVALUATION REPORT FER-158
Round Valley Fault Zone, Inyo and Mono Counties

by

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INTRODUCTION

Potentially active faults located in southern Mono and northern Inyo Counties evaluated in this FER comprise the Round Valley fault zone (figure 1). The Round Valley/Wheeler Crest study area is located in parts of the Mt. Tom and Casa Diablo 15-minute quadrangles. These faults are evaluated as part of a statewide effort to evaluate faults for recency of activity. Those faults determined to be sufficiently active and well defined are zoned by the State Geologist as directed by the Alquist-Priolo Special Studies Zones Act (Hart, 1980).

SUMMARY OF AVAILABLE DATA

The Round Valley/Wheeler Crest study area is characterized by Basin and Range style down-to-the-east normal faulting. The Round Valley fault zone is characterized by one of the highest and most precipitous escarpments along the east face of the Sierra Nevada. Bateman (1965) terms this escarpment the Wheeler Crest scarp. Young faults along the base of the escarpment will be termed the Round Valley fault zone (after Clark, et al., 1984) in this FER. This is to distinguish this zone of recent faults from a north-trending, down-to-the-west fault just east of the Wheeler Crest summit (figure 1).

Topography in the study area ranges from the gently sloping, alluviated area of Round Valley to the extremely steep, rugged slopes of the Wheeler Crest escarpment. Elevations in the study area range from about 4,500 feet to over 13,000 feet. Development in the study area is very sparse. Subdivisions in the Swall Meadow area and the Union Carbide-owned development of Rovana near Pine Creek are the only areas currently used for residential purposes.

Predominant rock types in the study area include Mesozoic plutonic rocks and associated Mesozoic and Paleozoic roof pendant rocks in the Wheeler Crest area and Quaternary surficial desposits (Rinehart and Ross, 1957, Bateman, 1965, Bailey and Koeppen, 1977). Quaternary deposits include: glacial deposits of the Sherwin ($>$ 700,000 yrs. BP), Tahoe (60,000-130,000 yrs. BP), Tenaya ($\simeq$ 50,000 yrs. BP), and Tioga (13,000-20,000 yrs. BP) glacial stages; late Pleistocene to Holocene alluvium, and Holocene talus and colluvium (Rinehart and Ross, 1957; Bateman, 1965; Bailey and Koeppen, 1977).

ROUND VALLEY FAULT ZONE

The Round Valley fault zone is a major range front fault. Displacement across the fault zone is normal, down to the east. Topographic relief across the escarpment north of Pine Creek ranges from 5,800 feet to about 6,800 feet (Bateman, 1965). Displacement across the fault south of Pine Creek gradually lessens in magnitude primarily because the Sierra Nevada frontal fault steps east across a complex structural warp which Bateman (1965) terms the Coyote warp (see also Bryant, 1984) (figure 1). Cumulative displacement across the Round Valley fault zone generally is enhanced by the westward tilt of Round Valley toward the range front. This westward tilt is the result of down-warping ("reverse drag" of Bailey, et al., 1976) of the downthrown block across the Round Valley fault zone. Bateman (1965) estimates that the Pleistocene Bishop tuff east of the Wheeler Crest escarpment may be downwarped as much as 985 feet into Round Valley.

Traces of the Round Valley fault zone have been mapped by Rinehart and Ross (1957), Bateman (1965), Envicom (1976), and Bailey and Koeppen (1977) (figure 2). With a few exceptions, Bailey and Koeppen (1977) used the mapping of Rinehart and Ross in the Casa Diablo quadrangle.

Bateman (1965) mapped an essentially north-trending fault zone along the base of the range front. The Round Valley fault zone offsets Mesozoic rocks against latest Pleistocene to Holocene alluvium along a relatively continuous zone north of Pine Creek (figure 2). Bateman (1965) noted that the granitic bedrock adjacent to faults is commonly sheeted parallel to the fault plane. He assumed that the presence of sheeted granitic bedrock indicated faulting where other evidence was lacking. Bateman observed an exposure of the Round Valley fault zone in an entrenched gulley a few hundred feet west of the NW corner of Sec. 13, T6S, R30E (figure 2). The fault zone is about 20 feet wide and is characterized by brecciated and mylonitized granitic bedrock. Sheeting in the bedrock dips 70°E.

South of Pine Creek, the Round Valley fault steps east and is characterized by a zone of discontinuous fault segments (figure 2). Sense of displacement is predominantly east side down (valley side down), but a relatively wide zone of mountain-side-down faults is located between Elderberry Canyon and Horton Creek (figure 2). Most of these faults occur in bedrock, but to the south, they offset Holocene alluvium (Bateman, 1965) (figure 2). Three northwest-trending normal faults just northwest of Bishop Creek offset Tahoe glacial deposits and undifferentiated glacial till, but do not offset Tioga lateral moraines of Bishop Creek (or do not extend far enough to the south) (Bateman, 1965) (figure 2).

Rinehart and Ross (1957) mapped traces of the Round Valley fault zone in the Casa Diablo 15-minute quadrangle (figure 2). The trend of the Round Valley fault zone is arcuate (concave to the southwest) in the southwestern part of the Casa Diablo quadrangle. Rinehart and Ross mapped offset Holocene alluvium and talus deposits in the Swall Meadow, Sky Meadow Ranch, and Witcher Meadow areas (figure 2). An approximately located fault offsets Tahoe and Tioga lateral moraines of Rock Creek and Holocene talus deposits about one mile west of Rock Creek (Rinehart and Ross, 1957) (figure 2).

Bailey and Koeppen (1977) used the mapping of Rinehart and Ross (1957) along most of the Round Valley fault zone in the Casa Diablo quadrangle, except where noted on figure 2.

Envicom (1976) mapped a segment of the Round Valley fault zone in the Sky Meadow Ranch-Swall Meadow area (figure 2). This segment of the Round Valley fault zone is characterized by a relatively wide, complex zone of generally down-to-the-east normal faults. Envicom stated that westernmost segments of the Round Valley fault zone offset the most recent alluvial fan deposits. Fault segments to the east, according to Envicom, do not seem to be as active, although all fault traces offset Holocene deposits (based on mapping by Rinehart and Ross, 1957 and Bateman, 1965).

Clark, et al. (1984) calculated a preferred slip rate of 1mm/yr along the Round Valley fault zone, based on an offset Tioga moraine on the south side of Pine Creek (figure 2). The relationship of Tahoe and Tioga glacial deposits in Pine Creek is anomalous and indicates ongoing vertical offset. The Tioga moraine is higher than the adjacent, more extensive Tahoe moraine east of the Round Valley fault zone. It seems clear that post-Tahoe normal faulting has resulted in the deposition of younger Tioga moraines above the older and larger Tahoe moraine on the downthrown (eastern) block (Clark, 1979).

WHEELER CREST FAULT

Bateman (1965) mapped a sinuous, north-trending fault east of the Wheeler Crest summit (figure 2). The fault is characterized by a west-facing scarp and offsets Paleozoic roof pendant and Mesozoic plutonic rocks. Holocene alluvium conceals the fault (figure 2). Jennings (1975) indicates that evidence of Quaternary offset is lacking along the Wheeler Crest fault. Because of the lack of recent deposits across the fault, relative remoteness of the fault, and the limited air photo coverage of the fault available to this writer, no further evaluation was made of the Wheeler Crest fault.

INTERPRETATION OF AERIAL PHOTOGRAPHS AND FIELD OBSERVATIONS

Air photo interpretation by this writer of faults in the Round Valley/ Wheeler Crest study area was accomplished using U.S. Forest Service air photos (IN04, 1972, scale 1:15,840) and U.S. Bureau of Land Management air photos (CA01-77, 1977, 1:24,000 scale).

Approximately two days were spent in the Round Valley/Wheeler Crest area in November 1983 by this writer in order to verify selected fault segments interpreted from air photos. In addition, subtle features not observable on the air photos were mapped in the field. Results of air photo interpretation and field observations by this writer are summarized on figures 2 and 3.

Significant observations based on both air photo interpretation and field observations by this writer, and mapping by others, are summarized in Table 1. Locality numbers identified on figures 2 and 3 refer to specific data relative to fault recency, degree of definition (i.e., well defined or poorly defined), ages of deposits that are offset or that conceal faults, and additional pertinent information. Table 1, in conjunction with figures 2 and 3, contains the majority of supporting data relevant to zoning decisions.

An attempt was made to measure fault scarp profiles in order to estimate recency of faulting based on the work of Wallace (1977). Points of observation and locations where fault scarp profiles were measured are shown on figure 3 and are summarized in Table 2. It should be emphasized that these measurements represent only approximations of scarp height, scarp-slope angle, and width of scarp crest. Scarp height was measured using the method described by Lahee (1961, p. 454). Scarp-slope angle was estimated by using a Bunton compass clinometer and an improvised leveling rod, as described by Wallace (1977). The width of the scarp's crest was estimated by pacing.

A direct correlation between the ages indicated by fault scarp profiles measured by Wallace (1977) in Nevada and scarp profiles measured during investigations for this FER cannot be made due to different lithology, climate, and styles of faulting (Mayer, 1982). However, the data presented by Wallace (1977, 1978) can be used as a guide (or additional factor) when evaluating the geomorphic features and age of offset deposits (when known) for recency of faulting. Some very general guidelines for estimating scarp ages are summarized as follows: scarp-slope angles for faults in unconsolidated alluvium and colluvium no older than 10,000 to 12,000 yrs. BP can range from 10° to 35° (Wallace, 1977). The average scarp angle is about 22°, based on figure 8 of Wallace (1977), although figure 12 of Wallace (1977) indicates that scarp angles of about 19° represent minimum Holocene age. The scarp crest width for scarps no older than about 10,000 yrs. BP range from 3.2 to about 19 feet (figure 11 from Wallace, 1977). Wide variations occur, but these figures probably represent minimum (i.e. conservative) criteria suggesting Holocene ages.

ROUND VALLEY FAULT ZONE

The Round Valley fault zone is characterized by well-defined scarps and breaks in slope at the base of a very prominent east-facing escarpment. The Round Valley fault zone is well defined along most of its mapped trace (figure 3). The fault zone is less well defined and somewhat discontinuous along its northern end northwest of the Witcher Meadow area (figure 3). Faults mapped by Bateman (1965), Rinehart and Ross (1957), and Envicom (1976) were generally verified by this writer, although differences in detail exist (figures 2, 3). Geomorphic evidence of Holocene faulting is abundant along most segments of the Round Valley fault zone and includes scarps in alluvial fans and talus cones, vertically offset drainages, beheaded drainages, ponded alluvium, and linear troughs (localities 1, 2, 4, 5, 7, 11, 12, 13, figure 3, Table 1).

Alluvial fans issuing from the Wheeler Crest escarpment generally are extremely coarse-grained and have been deposited by episodic debris flows. The debris flow channels and associated lateral levees are good constructional surfaces that often can be matched across a scarp, demonstrating offset due to faulting rather than erosional processes. An arcuate, east-facing scarp at locality 1 is well defined and delineates a fault that vertically offsets an alluvial fan (figure 3). The close proximity and nature of drainages suggests that the east-facing scarp may be erosional. However, a young debris-flow lateral levee is vertically offset, demonstrating that the alluvial fan surface is vertically offset, and the east-facing scarp is a fault scarp. Similar relationships exist along segments of the Round Valley fault zone, such as at locality 12 (figure 3).

An exposure of the Round Valley fault zone was observed at locality 10 (figure 3). Prominent sheeting in granitic bedrock, which characterizes the fault zone, trends N05°E to N17°E and dips from 45° to 65°E. A shear fabric is developed in the bedrock and near vertical striations, ranging from poorly developed to well developed, indicate dip-slip displacement. No shears were observed in the talus on the east side of the fault, although it is doubtful that shear planes would be preserved in (or perhaps propagated through) the talus due to its coarse-grained, relatively cohesionless nature.

Bateman (1965) mapped a concealed fault along the southeast side of Pine Creek that he thought may connect with the Gable Creek segment of the Round Valley fault zone (figure 2). Mapping by Bryant (this report) suggests that a fault may be located along the northwest side of Pine Creek (figure 3). Geomorphic evidence suggesting recent faulting was observed at locality 16 (figure 3). However, the location of a normal fault in Pine Creek is problematical because the canyon was occupied by a glacier during the Pleistocene (Bateman, 1965). The linearity of the northwest side of Pine Creek may be the result of glacial erosion along a prominent, northeast-trending joint set. Additional alluvial fans do not seem to be offset along this inferred fault (except for an oversteepened alluvial fan about 2,500' northeast of locality 16). Remnants of Tioga lateral moraines are not offset along the northwest side of Pine Creek canyon (Sects. 23, 26, T6S, R30E) where one would anticipate a connection with the principal trace of the Round Valley fault zone (figure 3). Tailings ponds and other mining and processing activities southwest of locality 16 obscure any geomorphic evidence of offset along this inferred fault, which precludes establishing a connection with the Gable Creek segment of the Round Valley fault zone.

Geomorphic evidence indicating recent faulting was not observed along the Gable Creek segment of the Round Valley fault zone, based on air photo interpretation by this writer (locality 15, figure 2).

The extremely coarse nature of most alluvial fans (discussed previously in this section) influences the degree of preservation of scarp-slope angles along traces of the Round Valley fault zone. Many scarps in alluvial fans along the Round Valley fault zone are armored, thus yielding a slope angle suggesting a younger age than the scarp may actually be. The scarp profile measured at locality 11 (figure 3) may be a good test case because the age of the offset deposits are known. Tioga glacial deposits are offset, and the scarp slope is armored with granitic boulders. The slope angle is 29° at a point measured about a third of the way from the crest of the lateral moraine. The slope angle at the crest of the lateral moraine is 32°. Comparing Wallace's data on scarp-slope angles, one could conclude that the scarp was between 100 and 1,000 years old (based on slope angles measured in unconsolidated fanglomerate). This segment of the fault clearly offsets both Tioga lateral moraines and minor lateral moraines nested within the main Tioga moraine this writer assumes to represent a late-stage Tioga recessional period. Faulting post-dates deposition of these late-stage moraines, but it is not clear whether post-Tioga alluvial deposits are offset. Based on stratigraphic evidence, faulting has occurred at least within the last 13,000 years (Clark, et al., 1984), but not in latest Holocene time. Thus, early Holocene faulting is indicated, but a younger age of faulting (on the order of a few thousand years) is inferred.

Elsewhere along the Round Valley fault zone, talus cones and alluvial fans are offset. These features clearly are Holocene in age, based on well-defined constructional surfaces and lack of dissection. The lateral levees in all but the most recent stream channels are offset at locality 12. These offset levees indicate a very recent age of offset along this segment of the Round Valley fault zone, perhaps on the order of a few thousand years.

The young age of offset (100 to 1,000 years) indicated by scarp angles measured along offset moraines at Pine Creek is probably incorrect due to the armored face of the fault scarp. However, relatively youthful features offset along other segments of the Round Valley fault zone indicate faulting that may be on the order of several thousand years, based on the morphology of the offset surfaces. Thus, scarp-slope angles seem to be a valid indicator of Holocene activity (if evaluated in association with additional geologic information), even though scarp slopes may be armored.

SEISMICITY

The Round Valley/Wheeler Crest study area is probably the most seismically active area along the eastern Sierra Nevada, with the exception of the recent seismicity occurring at Mammoth Lakes. Epicenter locations for the period 1900-1974 are shown in figure 4a. Many epicenters are located east of the east-dipping Round Valley fault zone, indicating an association between the fault zone and seismicity. However, other epicenters lie to the west of the fault zone. The quality of epicenter locations and the paucity of the seismic network during this timeframe preclude the matching of specific seismic events with specific fault segments.

A M5.8 earthquake occurred October 4, 1978 and was located north of Wheeler Crest (event 1, figure 4b). The aftershock sequence of this earthquake swarm aligns along a north-south trend. The relative locations of the epicenters (using a modified master event technique) is thought to be fairly good (USGS B quality), although the actual spatial locations are not accurately known (Fuis, et al., 1979; Cramer and Toppozada, 1980). Focal mechanisms from the earthquake swarm indicate either right-lateral strike-slip motion along an east-west-trending fault or left-lateral strike-slip motion along a north-south-trending fault (Cramer and Toppozada, 1980).

Surface cracks were observed east of Paradise Camp in the Volcanic Tablelands (Fuis, et al., 1979). The cracks were extensional with maximum openings of 2 to 3mm. The cracks were located east of Rock Creek gorge and west of an east-dipping fault mapped by Bateman (1965). The zone of cracks was about 1 km long, 1/2 km wide, and was oriented parallel to Rock Creek. It was concluded that the cracks were not tectonic, but were probably related to slumping into Rock Creek gorge (Fuis, et al., 1979; M.M. Clark, p.c., January 1984). No surface rupture was observed in the epicentral area along the Round Valley fault zone (J. Kahle, p.c., December 1983; M.M. Clark, p.c. January 1984). Seismicity in this region along the northern end of the Round Valley fault zone has continued to the present along this apparent north-south trend and focal mechanisms continue to be consistent with those observed in the October 1978 earthquake swarm (M. Somerville, seminar on historic seismicity of Mammoth Lakes region, given January 4, 1984).

CONCLUSIONS

The Round Valley fault zone is a major range front fault characterized by predominantly down-to-the-east normal displacement. Bateman (1965) reported that maximum topographic relief across the Wheeler Crest escarpment, one of the most precipitous escarpments along the east face of the Sierra Nevada, ranges from 5,800 feet to 6,800 feet. The Round Valley fault zone is characterized by well-defined geomorphic features indicating Holocene normal faulting (Table 1, figure 3). Well-defined scarps in alluvium and vertically offset drainages delineate segments of the Round Valley fault zone (figure 3). Tioga glacial moraines and alluvial fans and talus cones of Holocene age (Bateman, 1965; Envicom, 1976; Bryant, this report) are offset along the Round Valley fault zone. Fault scarp profiles (Table 2) along selected segments of the Round Valley fault zone support Holocene activity, although armored scarps along most of the fault segments measured infer ages that are probably too young. However, Holocene activity is clearly indicated.

Bateman (1965) mapped a concealed fault along the southeast side of Pine Creek. An inferred fault along the northwest side of Pine Creek was mapped by Bryant (this report) (figure 3, this report). Geomorphic evidence suggesting recent activity was observed along portions of the inferred fault, but systematic geomorphic features supporting a fault origin were not observed. Pine Creek has undergone glacial erosion, and it is not clear if the observed geomorphic features are erosional or fault related. Additional field work is necessary in order to possibly resolve the origin of linear features along the northwest side of Pine Creek.

Geomorphic evidence of recent faulting was not observed along the Gable Creek segment of the Round Valley fault zone (figure 2).

RECOMMENDATIONS

Recommendations for zoning faults for special studies are based on the criteria of "sufficiently active" and "well defined" (Hart, 1980).

ROUND VALLEY FAULT ZONE

Zone for special studies well-defined faults shown on figures 5a, 5b, 5c, 5d, and 5e. Principal references cited should be Bateman (1965), Rinehart and Ross (1957), and this FER. Do not zone the Gable Creek segment and the Pine Creek segment of the Round Valley fault zone. The Gable Creek segment is not well defined and does not seem to be sufficiently active. The Pine Creek segment has not adequately been demonstrated to be a fault. Therefore, additional work should be undertaken to determine the origin of geomorphic features along the northwest side of Pine Creek, if time permits.

FER reviewed, recommendations approved. Earl W. Hart CEG 935 3/29/84

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Table 1 (to FER-158) Locality descriptions listing selected data pertinent to fault recency, based on air photo interpretation and field observations by Bryant (this report). Additional data pertinent to fault recency are based on the work of others.

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
1 (fig. 3)	Round Valley fault zone (RVFZ)	scarp; dd	Holocene alluvial fan deposits (Bateman, 1965)	Principal fault is arcuate, concave to the east. Deflected drainages are associated with fault. It could be argued that scarp is erosional. However,levee from debris flow is vertically offset, strongly indicating that scarp is due to faulting and alluvial surfaces are offset.
2 (fig. 3)	RVFZ	scarp; dov	Holocene talus (Bateman, 1965)	Two minor drainages developed on talus cone are vertically offset. Holocene age of talus cone indicated by relative lack of dissection and constructional surfaces. Difference in vegetation growth on downthrown block suggests that veneer of talus may have been deposited across scarp to north(across drainage)well-defined, E-facing scarp in alluvial fan has scarp angle of 32°. Scarp is greater than 50' high.
3 (fig. 3)	RVFZ	ld; scarp	Pleistocene alluvium (Bryant, this report)	Fault mapped by Envicom (1976). I can verify W-facing scarp in alluvial fan, although scarp has been modified by drainage developed along toe of scarp. Envicom observed flt. in roadcut exposure (lower rd). This writer unable to verify presence of flt.in upper roadcut exposure. Lithology exposed in roadcut is massive to poorly bedded, bouldery gravel with

1 Unless otherwise noted, all observations by Bryant (this report), based on air photo interpretation and field checking. Field observations indicated on figures 2, 3. Refer to figure 3 for symbol explanations.

Table 1 (to FER-158)

Locality Descriptions

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
3 (fig. 3) (contd)				sparse lenses of sand. The general lack of stratigraphy and the coarseness of the deposits result in difficulty in observing (and preservation of)discrete flt.planes. Envicom indicates that age of material offset in lower road is Holocene, based on mapping by USGS(Rinehart & Ross, 1957?). However,deposits observed by this writer in upper roadcut(which presumably is stratigraphically higher & younger than deposits in lower roadcut)have reddish paleosols developed on some of the"paleo-surfaces", suggesting that lower units in the fan are pre-Holocene in age. A flt. is suggested east of the W-facing scarp. A reddish paleosol seems to be truncated. The contact between this paleosol and overlying colluvial deposit is not offset. No discrete shear planes observed.
4 (fig. 3)	RVFZ	scarp; t; vegetation contrasts, cd; tr or graben	Holocene alluvium and talus (Rinehart & Ross, 1957)	Complex zone of faults in Swall Meadow area. Principal flt. W. of Small Meadow is very well defined and offsets young talus cones of probable Holocene age.Scarp profile in relatively unconsolidated allu-vium(coarse, cobbly gravel with boulders): h= 60' $\measuredangle$ =32° c=sharp.This scarp forms W. side of graben. Flowing spring located in canyon just north of & on trend with this scarp.Many faults located east of main flt.,

Table 1 (to FER-158)

Locality Descriptions

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
4 (contd)				but generally these flts. not as well defined. However, alluvium is very wet most of the year and flowing springs were observed during field check in early November. The alluvium is finer grained than the alluvial fan and talus deposits; thus scarps may be less well preserved. Most faults delineated by vegetation contrasts. Subtle scarp observed ($\measuredangle = 15^\circ$) associated with strong vegetation contrasts (groundwater barriers). Height of scarp about 3', but dense brush along base of scarp didn't allow proper measurement.
5 (fig. 3)	RVFZ	scarp	Holocene alluvium (Rinehart & Ross, 1957)	graben in alluvial fan (cone)

Table 1 (to FER-158)

Locality Descriptions

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
6 (fig.2, 3)	RVFZ	scarp	Tioga lateral moraines (Bailey and and Koeppen, 1977)	Small backfacing scarp(SW-facing offsets Tahoe and Tioga lateral(Rinehart & Ross, 1957) and Tioga recessional? moraines. The RVFZ probably is distributive near this location because magnitude of offset of Tahoe lateral moraine is much less(and the scarp is not well defined in Tahoe lateral moraine),than one would expect, based on offset talus deposits to SE. I cannot verify location of fault in lateral moraine mapped by Rinehart & Ross (1957) about 2000' south of this location. Bailey and Koeppen (1977)generally use Rinehart & Ross's trace, but show two short faults across the eastern lateral moraine(which offset Tioga, Tenaya, and Tahoe deposits). Their northern trace is close to mine, but I can't verify location of either trace.
7 (fig. 3)	RVFZ	scarp; t	Holocene talus (Bryant, this report)	Well-defined scarp in young talus deposits. Rinehart & Ross (1957) do not map the young talus cone as offset. However, fault clearly offsets talus cone surface. About 2000' north of this location, fault offsets another talus cone. Modern drainage on talus cone surface seems to be vertically offset.

Table 1 (to FER-158)

Locality Descriptions

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
8 (fig. 3)	RVFZ	back-facing scarp; veg. contrasts	Holocene talus (colluvium of Bailey and Koeppen, 1977; Rinehart and Ross, 1957)	Back-facing scarp in bedrock is relatively well defined, but somewhat broad; scarp (up to the north) extends to talus slope and offsets the surface vertically. However, the scarp is rounded, indicating that material has been draped over scarp. Bailey & Koeppen (1977) and Rinehart and Ross's (1957) traces almost coincide with the fault mapped by this writer.
9 (fig. 2)	RVFZ	dd	N/A	Fault mapped by Bateman (1965) east of main trace is not well defined--location is suggested by deflected drainages, but no associated geomorphic evidence of faulting.
10 (fig. 3)	RVFZ	scarp; bd?, dd	Holocene talus (Bateman, 1965)	Talus cones offset against granitic bedrock--well-developed sheeting in bedrock suggests flt. plane. Poorly developed shear fabric with crude, near-vertical striations--attitude of joint surface ranges from N05°E to N17°E and dips from 45° to 65°E. About 250' south of this location, better defined shear fabric with fairly well-defined vertical striations. About 650' south of locality 10, fault location is suggested by flowing springs and a break in slope in very young stream deposits.

Table 1 (to FER-158)

Locality Descriptions

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
11 (fig. 3)	RVFZ	scarp	Tioga glacial deposits (Bateman, 1965)	Scarp in Tioga lateral moraine. Fault offsets late-stage lateral moraine at this location. Scarp profile: h=25', $\measuredangle$=29°, c $\simeq$ 10'; scarp is armored with granitic boulders--at crest of Tioga lateral moraine, scarp-slope angle is 32°. South of Pine Creek, scarp in lateral moraine is much better defined & offsets three large-stage Tioga (Tioga recessional?) lateral moraines--no evidence of scarp in Pine Creek, but extremely high energy environment of Pine Creek precludes preservation of scarp in modern stream bed.
12 (fig. 3)	RVFZ	scarp	Holocene alluvial fan deposits (Bryant, this report)	Well-defined scarp in alluvial fan consists mainly of debris flow deposits that were laid down episodically and probably very rapidly. Fault offsets all but the very youngest of these deposits, which are probably historic. Several lateral levees are offset vertically, demonstrating that scarp is fault-related rather than erosional and that the alluvial fan surface is offset.
13 (fig. 3)	RVFZ	scarp; dov	Holocene talus (Bateman, 1965)	Young talus cone vertically offset, lateral levees and channel vertically offset--all constructional surfaces offset. Very recent (historic) debris flow not offset.

Table 1 (to FER-158)

Locality Descriptions

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
14 (fig. 3)	RVFZ	scarp; dov; pa	Tioga glacial deposits (Bateman, 1965)	Complex constructional glacial terraine --scarp vertically offsets rounded lateral moraines; material probably is somewhat cohesionless at this location. Talus cone 1000' south of this location is vertically offset--although magnitude of offset is less than other segments of RVFZ. This supports Bateman's (1965) observation that displacement along RVFZ diminishes to south when it trends close to Coyote Warp (see FER-153 for Coyote Warp explanation).
15 (fig. 2)	Gable Creek segment of RVFZ	sb	Holocene talus (Bateman, 1965)	Bateman (1965) mapped Holocene talus deposits offset along this fault. This writer could not verify that talus was offset. Location of fault suggested by sidehill bench, but Mesozoic bedrock underlying talus doesn't seem to be offset. Sidehill bench may be artificial --mining roads are located in this area and it seems unlikely that a sidehill bench would be preserved for very long on such a steep slope with ongoing movement of talus.
16 (fig. 3)	Pine Creek segment of RVFZ	scarp	N/A	Bateman (1965) postulated a concealed fault along the southeast side of Pine Creek that he thought might be a connection between the principal RVFZ and the Gable Creek segment (see fig. 2). A fault along the northwest side of Pine Creek is suggested by a linear escarp-

Table 1 (to FER-158)

Locality Descriptions

Locality #	Fault Name	Geomorphic feature delineating fault[1]	Youngest unit offset & source	Remarks[1]
16 (fig. 3) (contd)				ment and prominent sheeting in granitic bedrock, based on air photo interpretation by this writer. Attitude of 16 ~~(contd)~~ e) joints at locality 16: N10° to 15°E, dip 60° to 85°E. Prominent shear fabric indicating vertical offset not observed. Sheeting also may be due to glacial rebound. Break in slope (∡=32°) in talus cone aligns with scarp in alluvial fan. Minor drainage seems to be vertically offset (down to the E) coincident with scarp. Slope of young debris flow deposits (very coarse, boul-dery, unsorted alluvium) issuing forth from canyon seems to steepen across projection of scarp, suggesting recent faulting.

Table 2 (to FER-158)

Fault Scarp Profiles

Fault Name	Height	Slope Angle	Crest Width	Material Offset	Fault Type
Round Valley flt. Sect.14,T5S,R30E	15'	29°	NM	Holocene alluvium	normal
Round Valley flt. Sect.14,T5S,R30E	36'	30°	5'	Holocene talus	normal
Round Valley flt. Sect.14,T5S,R30E	$>$60'	32°	sharp	Holocene talus	normal
Round Valley flt. Sect.23,T5S,R30E	NM ($>$50')	32°	NM	Holocene(?)alluvium	normal
Round Valley flt. Sect.23,T5S,R30E	NM ($>$3')	15°	NM	Holocene alluvium	normal
Round Valley flt. Sect.23,T5S,R30E	NM	20°	NM	Holocene alluvium	normal
Round Valley flt. Sect.26,T6S,R30E	25'	29°	$\simeq$ 10'	Tioga glacial deposits(lateral moraine)	normal
Round Valley flt. Sect.23,T6S,R30E	NM	32°	NM	Tioga glacial deposits(lateral moraine)	normal
Round Valley flt. Sect.23,T6S,R30E	NM	33°	NM	Holocene(?)alluvium	normal

NM - not measured.

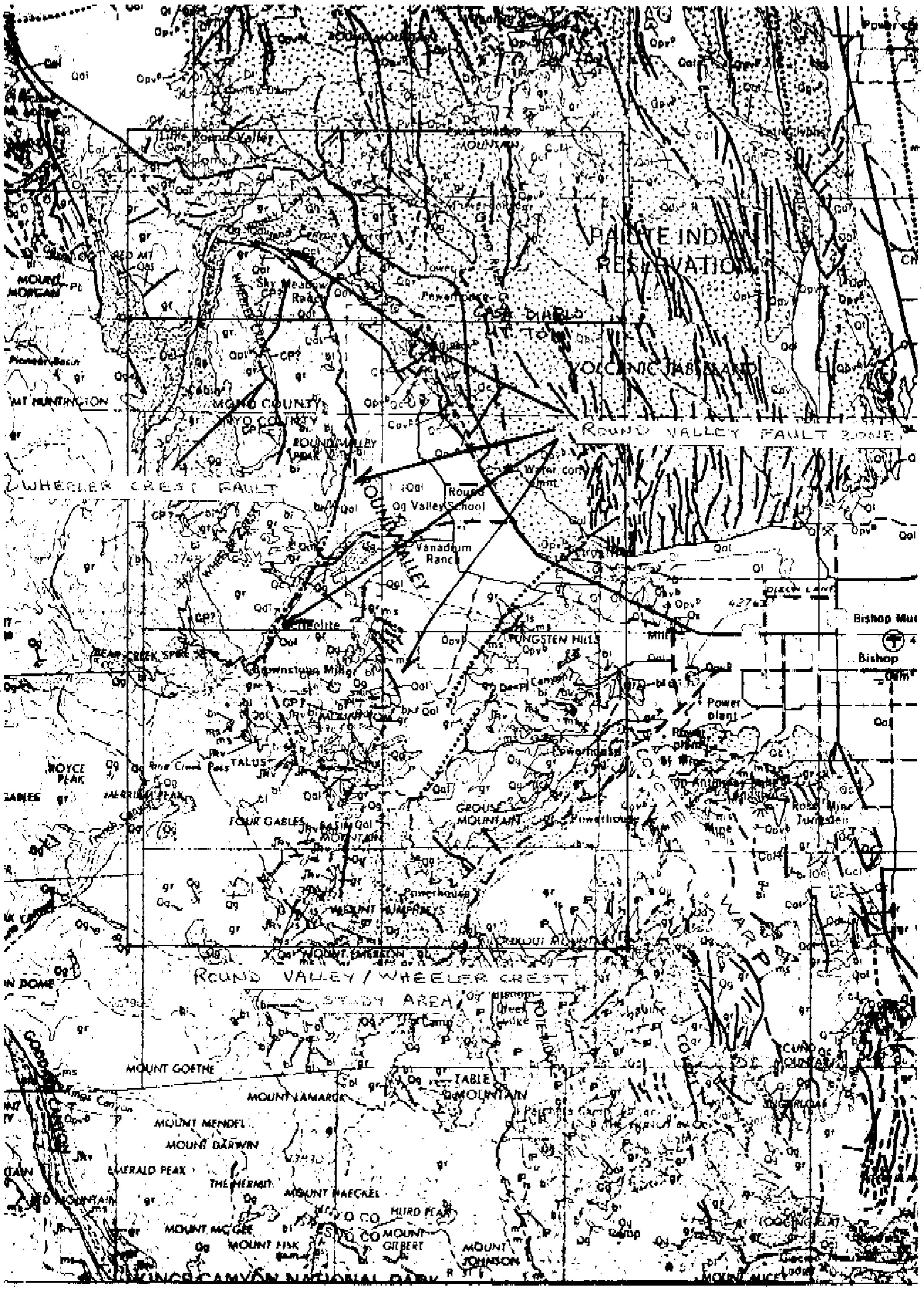

Figure 1 (to FER-158). Location of faults in the Round Valley/Wheeler Crest study area. Base map from Strand (1967), scale 1:250,000.

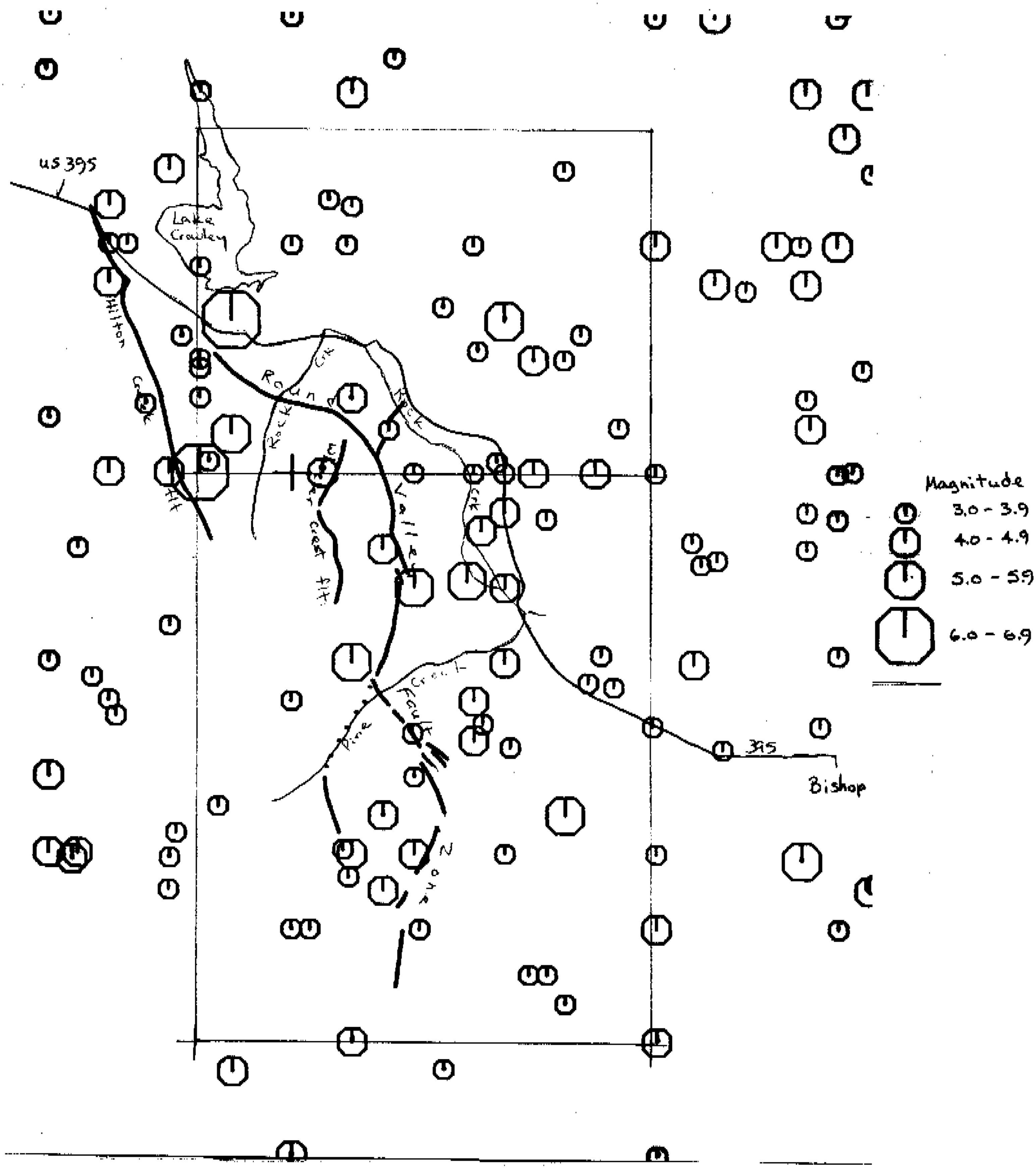

Figure 4a (to FER-158). Plot of seismicity in the Round Valley/ Wheeler Crest study area for the period 1900-1974. Quality of epicenter locations ranges from A to D and are mainly from CIT (Real, et al., 1978). Faults simplified from Strand (1967), scale 1:250,000.

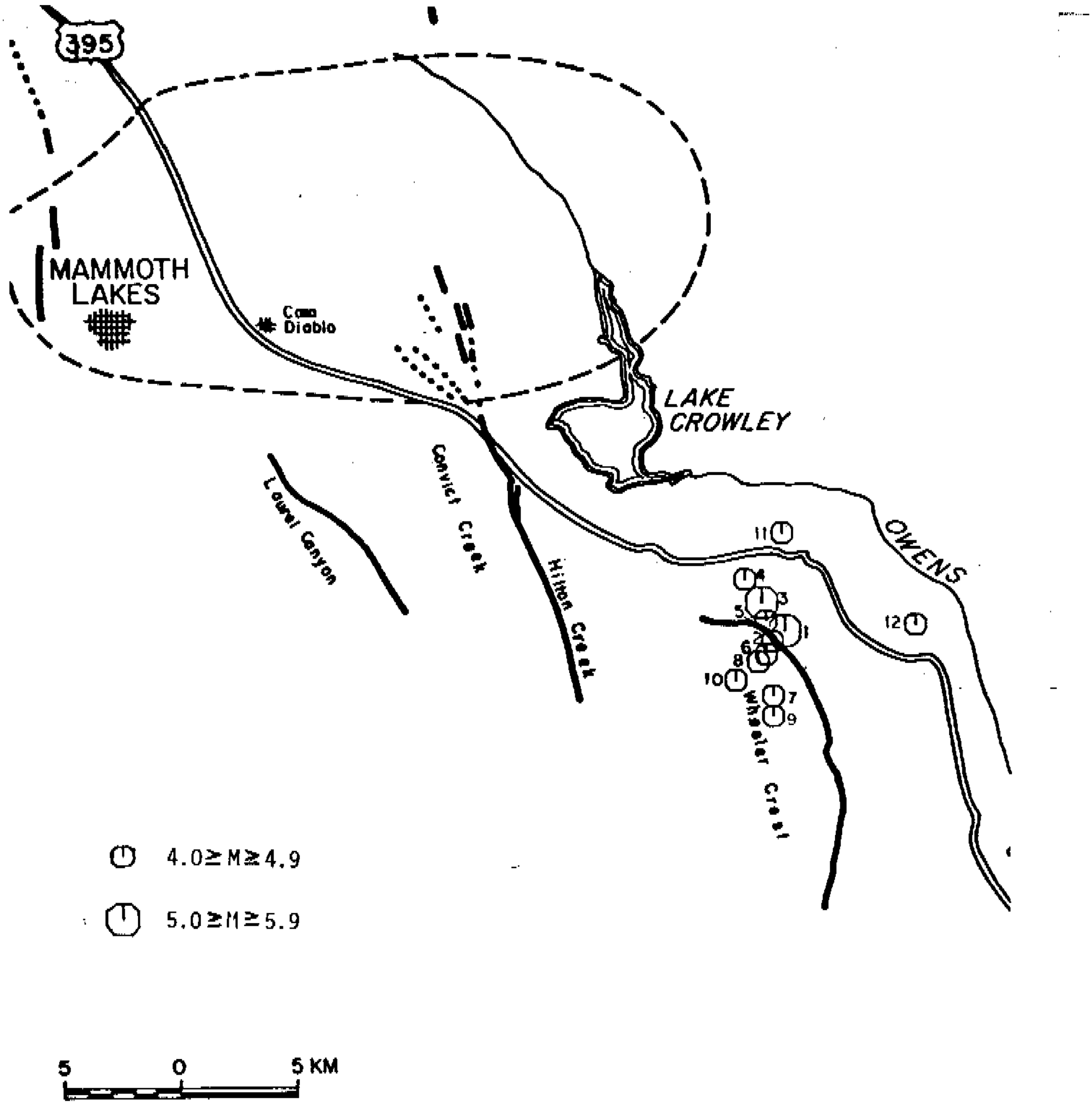

Figure 4b (to FER-158). Location of October 1978 earthquake swarm south of Lake Crowley. The main shock was M 5.8. Epicenter location quality is B (see text for discussion). From Cramer and Toppozada, 1980.